Fire and Fuels Specialist Report

Pahvant Interagency Fuels Reduction Project

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Background

On August 22, 2002, President Bush announced the Healthy Forest Initiative (HFI) for Wildfire Prevention and Stronger Communities. The Healthy Forests Initiative implements core components of the consensus 10-year Implementation Plan agreed to by states, tribes, and Stakeholders. These proposed treatments further the goals of the President's initiative. They will reduce the threat of catastrophic wildfires to protect communities, firefighters, wildlife, and forest health.

"Operating principles directed by the Chief of the Forest Service in implementing this report include: firefighting readiness, prevention through education, rehabilitation, hazardous fuel reduction, restoration, collaborative stewardship, monitoring, jobs, and applied research and technology", (from Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy, pp 11-12*.)*

The hazardous fuel reduction portion of this strategy states, "Assign highest priority for hazardous fuels reduction to communities at risk, readily accessible municipal watershed, threatened and endangered species habitat, and other important local features, where conditions favor uncharacteristically intense fires. " (ibid, pp12).

The Pahvant Interagency Fuels Reduction Project responds to the fuels reduction element of the Cohesive Strategy. The National Fire Plan specifies that communities at risk as identified in the Federal Register are the first priorities for hazardous fuels reduction treatments. The following communities, which occur along the Pahvant Front Range, are identified as priorities in the Federal Register: Scipio, Holden, Fillmore, and Meadow.

The Pahvant Interagency Fuels Reduction Project is the number one priority of 10 focus fuels areas that the Central Utah Interagency Fuels and Wildland Urban Interface committee has identified. Focus fuels areas are those that have a combination of fuels, fire risk and human risk factors that place them at a high potential for wildfire damage. This project is part of a long-term program to reduce fire risk and restore healthy fire-adapted ecosystems on Federal lands in Central Utah.

Purpose and Need

The purpose of this Pahvant Interagency Fuels Reduction Project is to reduce the risk of uncharacteristic wildfire and secondary effects, such as flooding, to communities and the environment while providing for firefighter safety. These communities include Scipio, Holden, Fillmore, and Meadow. There is a need to reduce hazardous fuels and affect a change in fire behavior.

The communities of Scipio, Holden, Fillmore and Meadow are within a wildland urban interface, the highest priority for treatment, as identified in the National Fire Plan. Reducing risk to these communities and the environment can best be achieved by manipulating vegetation to reduce fuels. A comparison of fuel conditions and fire behavior is provided below.

	Existing Condition	Desired Condition
Fuel Heights (feet)	3-20	<2
Fuel Loads (tons per acre)	3-30	<5
Fire Intensity (btu/ft/sec)	190-24,000	<500
Flame Length (feet)	10-45	2-8

Table 1. Desired and existing fuels and fire behavior conditions.

These figures indicate the ranges for the three vegetative types targeted for treatment, based on actual figures for each vegetation type as discussed below

The steep canyons, and dense fuels adjacent to these communities have the potential to burn hot enough to prevent safe and effective deployment of suppression resources for the protection of individual homes, communities and watershed values. Predicted fire behavior modeling of representative fuel types indicates that high intensity fire with high flame lengths and rapid rates of spread would be likely under moderate and higher weather conditions.

Proposed Action

The Fillmore Ranger District of the Fishlake National Forest (NF), and the Fillmore Field Office of the Bureau of Land Management (BLM) are proposing to treat approximately 14,329 acres of hazardous fuel accumulations along the western slopes of the Pahvant Mountain Range (Front Range). Treatments would occur in seven treatment units ranging from approximately 490 to 4,929 acres in size. Vegetation to be treated includes sagebrush-grasslands, pinyon-juniper, Gambel oak, and mountain brush.

The proposed action is to reduce hazardous fuels by reducing fuel height and fuel loads. Approximately 40-80 percent of the vegetation would be removed in each treatment unit. Treatment methods include cutting vegetation by hand; piling or scattering cut vegetation; burning cut vegetation by hand or aerial ignition device; and broadcast burning by hand or aerial ignition device. Treatments involving broadcast burning would occur mainly during spring and fall months. Cutting could occur any time of year. Treatments would begin in 2003 and are anticipated to be completed by 2008.

The following design features would be implemented as part of the proposed action:

- Low- to moderate-intensity prescribed fire would be used in order to promote the creation of a patchwork burn pattern of burned and unburned vegetation, and to protect soil resources.

- Where necessary, hand or “black” lines would be constructed along the perimeters of treatment units in order to contain prescribed fire within the treatment units. Hand lines and black lines are created by removing vegetation along a line by hand tools or hand burning, respectively. These lines would be constructed prior to the implementation of treatments that involve the use of prescribed burning.

- No fire lines would be constructed through known significant heritage sites. A minimum 100-foot buffer of untreated vegetation would be left around significant heritage sites. Vegetation may be cleared along the perimeter of the 100-foot buffer to exclude fire or reduce fire intensity. Prior to ignition, an archeologist would assist fire personnel to identify any other appropriate protection measures.

- Grazing pastures within treatment units would be rested from livestock grazing for a minimum of two growing seasons following a prescribed burn in that unit. Pastures would be rested for an additional season(s), where necessary to allow grasses to rejuvenate.

- One to two trees per acre would be retained for wildlife habitat in pinyon-juniper targeted for cutting. Trees with cavities that are observed during cutting of pinyon or junipers would be retained for cavity nesting bird species.

- Where necessary, treated areas may be seeded to promote recovery of ground cover to protect soil resources. Seed mixes may be comprised of grass, forbs, and shrubs. Only noxious weed free seed mixes would be used.

- The Forest Service and BLM would prepare a prescribed fire burn plan for each treatment unit prior to prescribed burning. The prescribed burn plan would describe methods and conditions under which prescribed burning would occur in order to accomplish project objectives.

Unit Name	Total Unit Size (acres)	NF Acreage	BLM Acreage	Vegetation Type Targeted for Treatment	Primary Treatment Methods
Grabalt	2,352	914	1,438	78% pinyon-juniper 20% Gambel oak 2% Sagebrush/grass/forb	Cutting & burning by hand
Wild Goose	1,578	1,578	N/A	58 % pinyon-juniper 42% Gambel oak	Burning by hand or aerial ignition

					device
Holden Springs	1,943	N/A	1,943	68% pinyon-juniper 32% sagebrush/grass/forb	Cutting* & burning by hand
Pioneer	1,603	1,149	454	38% pinyon-juniper 33% Gambel oak 29% sagebrush/grass/forb	Cutting* by hand, burning by hand or aerial ignition device
Frampton Heights	490	N/A	490	65% pinyon-juniper 35% sagebrush/grass/forb	Cutting and piling,* pile burning by hand
Horse Hollow	1,434	1,434	N/A	51% pinyon-juniper 49% Gambel oak	Burning by hand or aerial ignition device
Meadow	4,929	2,195	2,734	43% Gambel oak 35% sagebrush/grass/forb 22% pinyon-juniper	Cutting* by hand, burning by hand or aerial ignition device

Table 2. Treatment Unit Name, Acreage, Vegetation, and Treatment Method.

* Cutting on BLM portions of these units has already by analyzed by the following BLM Environmental Assessments:

- Holden Springs – Holden EA, 1991, updated 6/99; no treatment has occurred thus far
- Frampton Heights & Pioneer – Frampton EA, 1996, updated 6/99; some cutting has occurred
- Meadow – Meadow EA, 1997, updated 6/99; cutting is nearing completion

Collaboration and Cooperation

The Fillmore District of the Fishlake National Forest initiated a large-scale hazardous fuels reduction project along the Pahvant Front Range two years ago. During discussions with local BLM and State of Utah units, it was determined that an

interagency project would best meet hazardous fuels reduction needs in this area. Due to funding and competing priorities the project had not come to fruition. In the meantime, interagency discussions and project planning continued to occur on a regular basis.

Recently, fuels project prioritization recommendations were delegated to the Central Utah Fuels and Wildland /Urban Interface Committee. This committee consists of representatives from land management agencies in the Central Utah area, including U.S. Forest Service, BLM and the State of Utah. Projects are designed on an interagency basis to reduce hazardous fuels and create defensible space. During the 2002 annual review of proposed hazardous fuels treatments, the Fuels and Wildland/Urban Interface Committee was strongly supported by all agencies' line officers in their recommendation to complete the Pahvant project.

Federal and State managers are collaborating with the Millard County Fire District and the Millard County Fire Chief's association. These groups are very supportive of the Pahvant Interagency Fuels Reduction Project and letters in support of this project have been drafted. Millard County Commissioners have been informed and involved and are also very encouraging.

Defensible space and hazardous fuels reduction activities are being implemented on private and adjacent Utah Division of Wildlife Resources lands. Fuels reductions have been completed on 50% of private properties adjacent to the Frampton Heights unit. These activities are continuing to create defensible space on the Federal land next to the remaining 50% of private homes and properties, with an estimated completion date in spring of 2004. Private land owners are encouraging nearby federal fuels reduction projects because they have experienced firsthand the threat and detrimental effects of previous wildfires. A private landowner with a fairly large in-holding is presently creating defensible space on the private land below the Holden Springs unit. As a result of recent destructive wildfires, the County, State and Federal agencies have been actively involved in fuels reduction and defensible space activities in this high priority treatment area for central Utah.

This project also demonstrates the Department of Interior and Department of Agriculture commitment to working together to lessen the threat of uncharacteristic wildfire by restoring forest and rangeland health.

Affected Environment – Existing Condition

	Sagebrush/Grass/Forb	Gambel Oak/mountain brush	Pinyon-Juniper
Fuel Height (average)	**3 feet**	**18 feet**	**20 feet**
Fuel Load	**3 tons/acre**	**25-30 tons/acre**	**7-15 tons/acre**
Flame Length*	**15 feet**	**20-45 feet**	**10-25 feet**
Fireline Intensity*	**190-1545**	**2739-24,000**	**2739-24,000**

Table 3. Existing Fuels and Fire Behavior Conditions for the Vegetation Types Targeted for Treatment

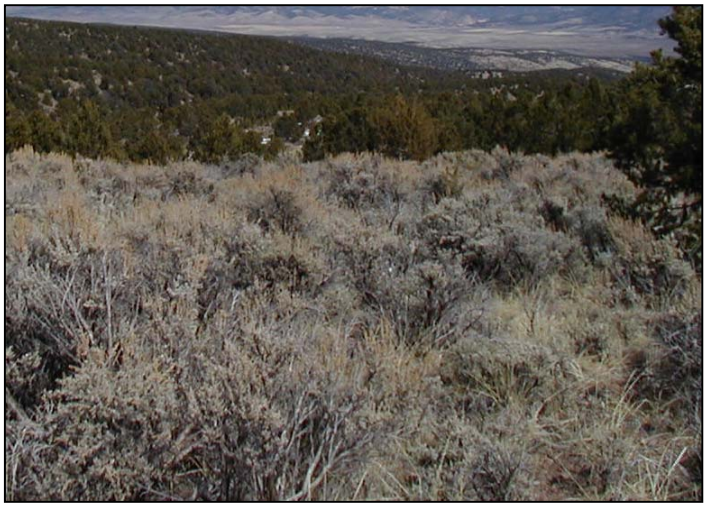
*** Based on predictive modeling and observed flame lengths on wildfires.**

Fire History and Current Vegetation

Historically, the Pahvant Front area's vegetation is fire adapted. Fire played a regular disturbance role in these ecosystems, varying by ecosystem. Fire exclusion has occurred in this area since the Europeans arrived, affecting the analysis area since at least the 1850s. The fuel now is taller and denser overall, with more tons of fuel per acre available to burn. This is especially true in areas that have changed from mixed grass and sagebrush to pinyon/juniper fuels and the mountain brush fuel types.

Sagebrush/grass/forb

Sagebrush/grass/forb communities are inhabited by mature basin big sagebrush and declining populations of grass and forbs. Pre-European fires in the area carried through fine fuels and created structural and age class diversity in the sagebrush. Fire exclusion has resulted in mature sagebrush with increasing dead to live woody material ratios and decreasing understory grasses and forbs. Infrequent fires in the last 150 years have allowed pinyon and juniper to encroach into these once open savannah-like meadows. Average fuel loads in this type are about 3 tons per acre now.



Historically, frequent (20-40 year interval) low to mixed severity fires would have reduced the density of pinyon and juniper in the valleys and maintained a patchwork of uneven aged sagebrush with an understory of perennial grasses and forbs. Under the historic fire

regime, these loads would have been kept to around 1 to 1.5 tons per acre, (Ottmar, 1998, p66-67). Historic photos of this fuel type show very little pinyon and juniper occurring in the area. This vegetative transition has shifted the historic mixed severity fire regime to one of a higher severity, stand replacement type fire regime.

The lower elevation areas burned more frequently, with the higher elevations burning less frequently on average. Data from nearby Monroe Mountain (Chappell, 1997) show that fires that would have burned historically have not occurred in the past hundred years on the regular basis they did in the previous 200 to 400 years. Monroe Mountain is the next mountain range east of the Pahvant Range, so it is likely that fires operated similarly in these ecosystems.

Gambel Oak/Mountain Brush

Many factors have affected the fire regime in the Gambel oak/mountain brush zone since settlement. Fires started by Native Americans have been eliminated, heavy grazing has removed fine fuels in which fire started and spread, and wildfires have been actively suppressed in the latter part of the 20th century. Vegetation associated with Gambel oak and bigtooth maple has also been altered by logging and the spread of exotic weedy plants. Paired historic and modern photographs of central Utah foothill sites indicate that oak and maple stands are now more extensive than they were 75 to 150 years ago, (Bradley, et. al., 1992).

The Dry Creek Canyon site (on Monroe Mountain) is similar to the upper elevation oak grading into conifer overstory sites on Pahvant. The historical fire interval was found to range from a fire every four years to a fire every 63 years, with an average interval of 30 years. Fire scar analysis shows the area has missed at least two stand-replacing fires, as it has been 75 years since the last known fire in this area.

Primarily, the tree form of Gambel oak is present in the analysis area. It appears as isolated even aged stands in the open and meadow areas. In moist years oak may act as a barrier to fire spread due to high live fuel moisture content and rapidly decomposing litter. In dry years oak brush is a flammable and explosive fuel type and will propagate crown fire spread on windy days. This is the same fuel type in which 14 firefighters were killed in 1994 in a fast moving crown fire in Colorado. Stands consist of mature plants with declining or absent perennial grasses and forbs. Amundson, et al. (1997) estimated that mixed severity fires burned in this fuel type every 20-50 years prior to European settlement.

Oak resprouts vigorously following fire and attains pre-burn heights in an average of 15 years (Bradley, et.al., 1992). This resprouting works to keep the fire hazard lower for a short term until the oak begins to again approach its pre-burn stand conditions. Fuel loads are typically in the 1 to 3 tons per acre range for young stands, while older stands, such as those present in the analysis area, produce 25 to 30 tons per acre with almost 50% of the stems dead. This dead component is present throughout the entire vertical profile of the stands, readily moving a fire from the surface and into the crowns.

Pinyon/Juniper

Pinyon/Juniper is the dominant cover type in the western third of the analysis area. It is present in most of the sagebrush/grass/forb areas and has increased its presence in this cover type tremendously over historical conditions. It occurs as closed stands throughout the analysis area and as a secondary species to Gambel oak. Much of the pinyon/juniper type has very little understory vegetation present and has a relatively closed canopy. This fuel type presents a unique fire hazard as it typically only will carry fire at higher wind speeds, but fires are likely to consume the entire stand at high intensities if wind speed is sufficient to sustain active crown fire. More typical fire behavior in these stands is small groups (one to five trees) burning without spreading to adjacent trees. Fuel loading in these type stands is between 6 and 13 tons per acre, depending on the percent of dead material in the crowns (Anderson , 1982).

In areas where the pinyon/juniper is more open, surface fuels such as sagebrush and grass are the primary carriers of the fire. In these stands, the pinyon/juniper contributes to the fire behavior by increasing the intensity of the fire and contributing to faster spread through preheating of adjacent fuels and spotting. Average fuel loads for more open pinyon/juniper areas ranges from 1 to 3 tons per acre.

Pinyon/juniper sites were also sampled in the Monroe Mountain Fire History. The average mean fire interval was found to be 50 years, with a range of 4 to 102 years. The document notes, “We suspect that the data here do not reflect the actual burn patterns occurring in pinyon-juniper (stands). Some lower severity ground fires may not cause scars and would not show up in this fire scar study. It is likely that there were many more low severity (non-scarring) fires in the pinyon-juniper woodlands before (European) settlement.” The average number of years since the last fire is 94. The fire

regime has converted from one with a short return interval, light to moderate surface fire to a long return interval moderate to severe stand-replacing fire, (Chappell, et.al., 1997).

The pinyon/juniper fuel loading data from the Horse Hollow and the Meadow unit of this project total between 7 to 10 tons per acre (see fuels data, Attachment 3).. Ocular estimates, using photo series comparisons put other units at 13 tons and above.

Historic Photos demonstrating fuel loading, (Charles Kay, 2002).

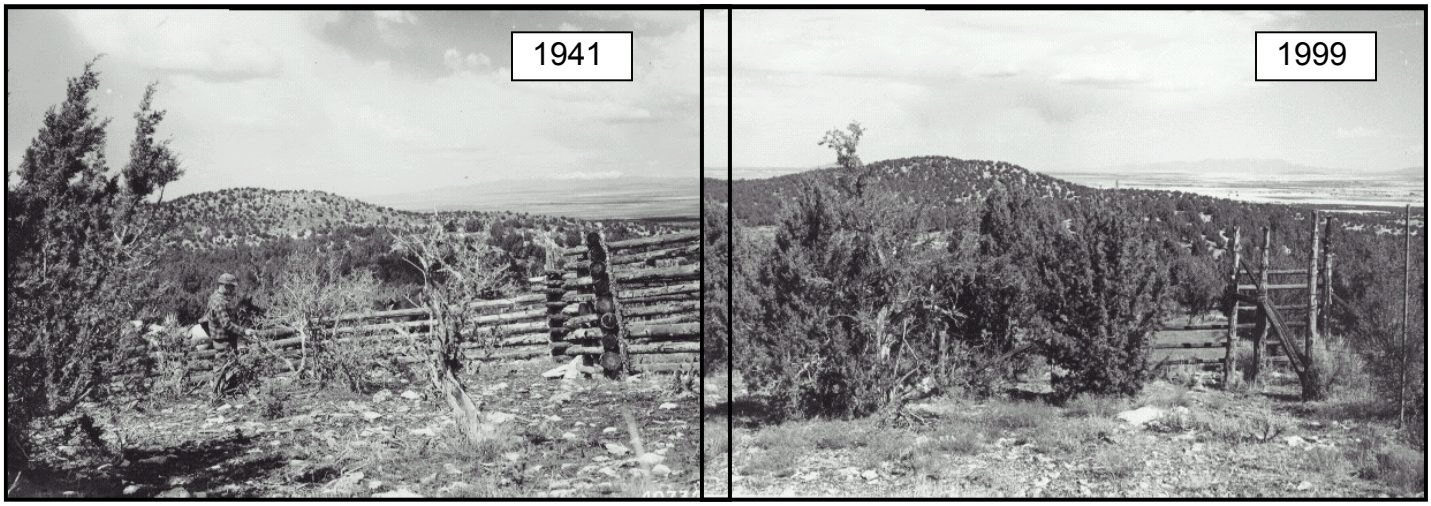
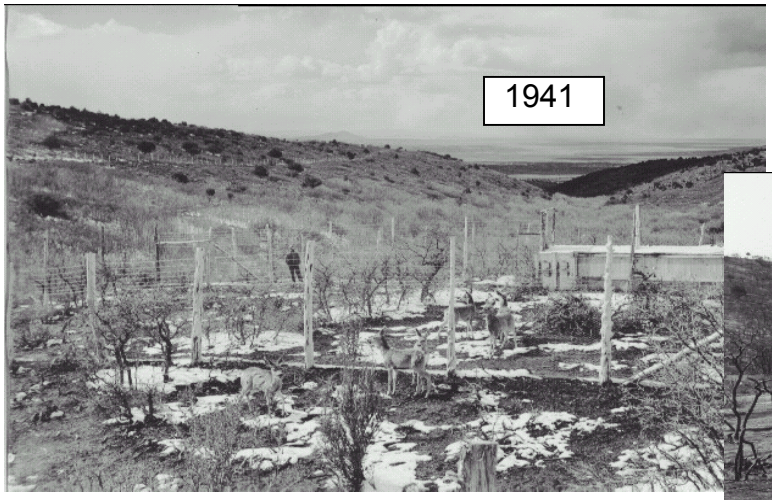
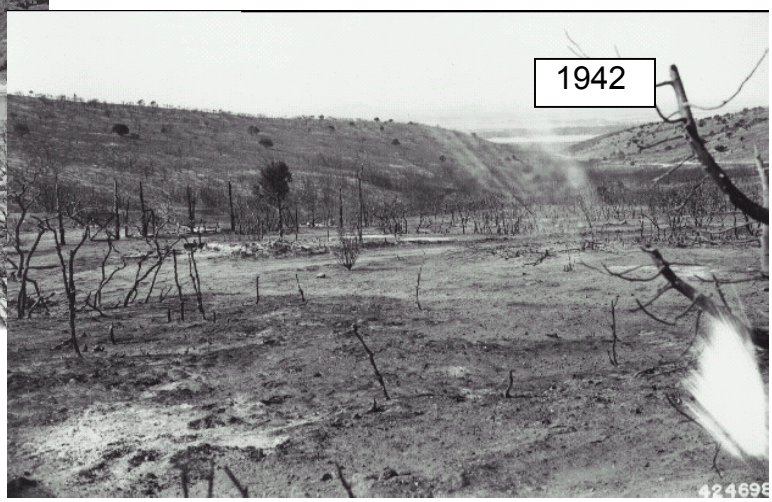


Photo Caption Dameron ExclosureT24S, R5W, Section 5 in the analysis area.

The juniper on the left edge of the photo in 1941 increased in size by 1999 and blocked the view so the camera was moved slightly forward for the 1999 photo. The cliffrose nearest the camera in 1941 died, the one by the person was still alive in 1999 but partly hidden from view by the two junipers that have grown up just inside the fence. There are no new cliffrose plants and deer still heavily used the existing shrubs. Pinyon and juniper appear to have increased on the distant hillside.





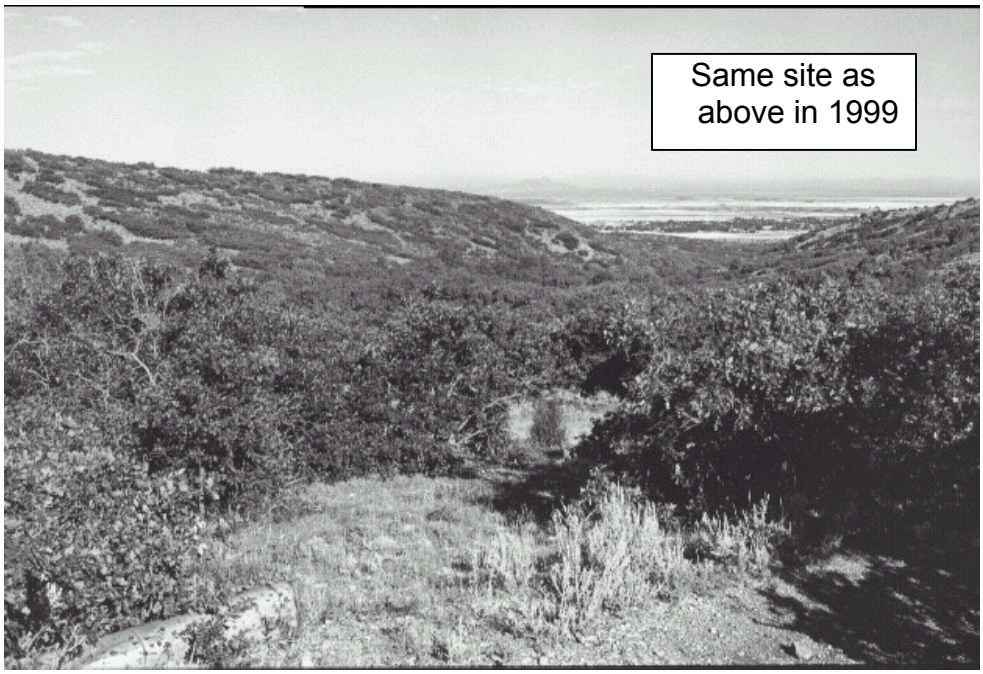


Plate 177 MAPLE HOLLOW: - 1999 LOCATION: Fishlake National Forest, Fillmore Ranger District; T24S, R4W, Sect. 10, UTM 4308350 N, 388300 E; elevation 6,000 ft., viewed to northwest. Although the fire severely burned most of the original vegetation, oak brush and maple were so thick in 1999 that the photo had to be taken from the nearest open area. The vegetation in 1999 shows little sign that a **raging crown fire** swept the area 50 years earlier. The oak brush was 15 to 20 feet tall and maple 20 to 30 feet tall in 1999. True mountain mahogany and sagebrush were also present in 1999.

Current Fire Behavior

During the recent uncharacteristic wildfires, fire behavior was hotter, more intense and faster moving. Flame lengths over 40 feet high were common in the Gambel oak and the pinyon/juniper fuel types. The sagebrush/grass/forb fuels regularly exhibited flame lengths up to 18 feet, making fires impossible to initial attack safely or successfully. Typically, these uncharacteristic fires can grow in size to 2000 acres in a single burning period. The Swains fire ran approximately 7000 acres in a day, moving from the foothills to the top of the Pahvant front in 28 minutes in a single, continuous run. The Meadow fire burned about 600 acres in 3 or 4 hours in an afternoon. The Keg fire, which ignited in the afternoon, ran 2500 acres in similar fuels to those in the proposed project.

Fire Behavior on the Swain's Fire, 2000. Flame lengths were over 200 feet.

The bottom line is that initial attack, utilizing all the available crews and engines, is unsuccessful on these hot dry windy days in this continuous heavy fuel. The result of these fast moving, uncharacteristically intense and severe fires is often soil damage, resulting in subsequent watershed damage and failure.

The fuels in the area have experienced fire exclusion over the past 150 years, creating an atypical fuel load across the area. Had fires continued to burn as they did historically, we would expect a mosaic of various fuel loads. However, now the continuous fuel loading increases the hazard of a fire easily spreading once it ignites, adding to the fire risk over a larger area. Risk is defined as the probability that potential harm or undesirable consequences will be realized. This includes that associated with adverse impacts to communities and losing key ecosystem components resulting from unwanted wildland fire (Cohesive Strategy, 2000).

Fire Occurrence

Almost 50% of all the wildland fires on the Fishlake National Forest each year start along the Pahvant front. More than 30 wildfires a year start on the west side of the

Pahvant Mountains. These fire starts have resulted in hundreds of thousands of dollars in fire suppression and burn rehabilitation costs over the last few years.

The table below shows fire occurrence by agency. Over the 15-year analysis period, there were 308 fires in the area and 36,384 acres burned. Average acres burned per year are 2426, which doesn't show the variety in fire seasons clearly. Fire occurrence years have ranged from fewer than 10 fires in 1999 to more than 45 fires in 2001. Acreage burned per year varies even more. There are five years with essentially no acreage reported, while in 1996 more than 18,000 acres burned within the Pahvant project boundary.

Agency	Number of fires	Acres Burned	Average acres burned/yr
BLM	38	12,261	817
FS	217	23,167	1545
State	53	956	64
Total	*308*	*36,384*	*2,426*

Table 4. Fire Occurrence by Agency within the analysis area, 1987-2001.

The years 1987-2001 were used in this report, as they were the years available in all three agencies' databases, allowing comparison of the same fire seasons. These same years also have weather records for the Remote Area Weather Station used to complete the fire behavior calculations.

Large fires occur primarily in late July and August when the fuels are driest and dry lightning is frequent. The table below displays the seasonal pattern of fires and acres burned. This data includes BLM, State and FS fires reported from 1987 through 2001. The general ignition pattern is the same for both agencies; most ignitions and large fires are in July and August. More supporting data are found in the Fire Occurrence Charts,. Attachment # 2,

Fires by Month	Fires	Acres Burned
May	3	0.3
June	32	115
July	92	10,547
August	140	25,367
September	39	354

Table 5. Number of Fires and Acreage by Month for all Agencies

Over the past 15 years (shown above) these July and August large wildfires have resulted in hundreds of thousands of dollars in fire suppression and burn rehabilitation costs on Federal, state and private lands along the Pahvant Front.

Topography and Weather

Fuels, weather and topography describe the fire environment. They work together to define fire behavior. The fuels element of the fire environment can be modified to

reduce potential fire behavior by changing the distribution, continuity and size and shape of fuels and fuel loading.

Topographic influences on fire behavior include slope, aspect, elevation, shape of the country, and the influence of topography on wind. Slopes along the Pahvant Front are quite steep, in some areas in excess of 100%. Slope increases fire behavior by preheating fuels upslope of the fire and enabling spotting from rolling and aerial firebrands. Flame length and rate of spread increase with increasing slope. Aspect is the direction a slope faces. Heavier fuel loadings tend to be on north aspects. South and southwest aspects typically experience the more severe fire behavior due primarily to duration of sun exposure and dominant wind directions in this part of the country. Winds in the project area are primarily from the southwest. Fires along the Pahvant Front move north and northeast in response to the winds. There are some diurnal winds, but only right in the mouths of the larger canyons.

Summers are typically hot and dry with daytime temperatures averaging 85° with single digit relative humidity and poor overnight recovery. The monsoonal pattern typically begins to set up in mid-July, but is neither reliable nor predictable. Lightning- caused fires occur primarily in July and August associated with the monsoonal pattern typical of the desert southwest. Often these thunderstorms produce dry lightning and strong winds with little or no moisture. The Pahvant Front receives many lightning strikes as the orographic lifting that occurs as the air masses climb over the mountains creates thunderstorms. This is a high natural ignition risk area

Hazard

Hazard is defined as: conditions which increase the potential for uncharacteristically intense wildland fire and decrease the capability to protect life, property and natural resources (Cohesive strategy, 2000). The Bureau of Land Management's Utah Statewide Fire Assessment,(Attachment #1) conducted in March 2000, places much of the proposed project area in a high to extreme fire hazard potential due to the fuels currently available to burn. The values at risk are listed as moderate to high, as there are quite a few outlying houses and five small towns in the area. This Statewide Fire Assessment supports using hazardous fuels reduction treatments to reduce potential catastrophic wildfire risk.

Fire Regime and Condition Class

The 2002 National Cohesive Strategy defines fire regimes as a generalized description of fire's role within an ecosystem – characterized by fire frequency, predictability, seasonality, intensity, duration and scale. This Pahvant Front project fits well into the National Fire Plan treatment strategy because although it is in Fire Regime IV now, it needs to be moved back into Fire Regime III, where it was historically. The strategy places a greater emphasis on restoration and fire maintenance treatments within those areas most prone to fire occurrence, specifically within Fire Regime Groups I, II, and III. These areas have experienced the greatest change from historical conditions due to fire exclusion. They are most likely to respond favorably to treatments designed to reduce hazardous fuel and improve ecosystem resiliency to wildland fire.

Fire intensity and frequency are shifting with changes in vegetative structure and composition. Simply put, fire intensity and frequency define fire regime (see glossary). Prior to European settlement in the Pahvant area, fires were frequent and of low to mixed severity within fire regimes II and III. With the loss of fine fuels such as grasses and the encroachment of pinyon-juniper and other woody plants into the area, the fire regime has shifted to one of lower frequency and higher intensity, primarily fire regime IV (table 5). Fire regime classifications used in this document are from Schmidt et al, 2002.

Fire Regime Group	Description
I	0-35 year frequency, low severity
II	0-35 year frequency, stand replacement severity
III	35-100+ year frequency, mixed severity
IV	35-100+ year frequency, stand replacement severity
V	200+ year frequency, stand replacement severity

Table 6. Historic Natural Fire Regimes. Frequency is the average number of years between fires. Severity is the effect of fire on the dominant overstory vegetation. (Schmidt et al, 2002).

The Pahvant project fuels are currently in fire regime IV. The fire regimes have changed from their historic fire regimes, as mentioned in the fire history section above. When functioning properly, it is likely that these units were actually in fire regime III.

Unit	Current Fire Regime	Historical Fire Regime	Current Condition Class	Desired Condition Class
Grabalt	IV	III	II	I
Wild Goose	IV	III	II	I
Holden Springs	IV	III	II	I
Pioneer	IV	III	III	I
Frampton Heights	IV	III	III	I
Horse Hollow	IV	III	II	I
Meadow	IV	III	III	I

Table 7. Current and historical Fire Regimes and Current and Desired Condition Class by Proposed Treatment Unit.

In the National Cohesive Strategy, wildfire risk conditions are identified by Fire Regime Groups. Condition class measures the departure from a functioning ecosystem. “The three Fire Condition Classes categorize and describe vegetative composition and structure conditions that currently exist inside the Fire Regime Groups. The risk of loss of key ecosystem component from unwanted wildland fire increases from Condition Class 1 (lowest risk) to Condition Class 3 (highest risk). “, (National Cohesive Strategy, 2000).

Historical fire regimes have changed from relatively frequent low or moderate intensity fires to much less frequent more intense fires. What this means is that when an ignition occurs, it is more likely to get bigger and hotter than in previous history. The result of bigger, hotter fires has been threatened homes, watershed damage and new weed invasions.

Fire Behavior

The major vegetation component loss has been in understory species, particularly grasses and forbs. This affects how and when a fire will occur. With loss of understory (and increase in woody fuels component), fire changes from spreading surface fire to a stand replacement type fire that is only sustained during windy conditions (Bradley et al, 1992). Current fuels are modeled as Fire Behavior Prediction System (FBPS) fuel models 4 (interior chaparral and late-season mountain brush) and fuel model 6 (pinyon-juniper and early season mountain brush) (Anderson, 1982). Under a 90th percentile weather condition, these fuels are modeled to produce flame lengths of 30 and 9 feet respectively with a 20-foot wind speed of 6 mph in unsheltered fuels. 90th percentile weather conditions describe weather and fuels conditions that occur on only 10% of the days May 1 – October 31. These weather conditions are explained in the direct and indirect effects section of this report and in the Behave Information and Fire Suppression Interpretations in Attachment. #4.

The steep canyons, and dense fuels adjacent to these communities have the potential to burn hot enough to prevent safe and effective deployment of suppression resources for the protection of individual homes, communities and watershed values. Predicted fire behavior modeling of representative fuel types indicates that high intensity fire with high flame lengths and rapid rates of spread would be likely under moderate and higher weather conditions.

Environmental Consequences

Alternative One – No Action

The only alternative to the proposed action is the no action alternative. Under this alternative no new treatments are proposed along the Pahvant Front. The adjacent and interior BLM (Frampton Heights, Pioneer and Meadow) units which have already had fuels cut will have increased dead fuel loading, creating an increased wildfire risk if those areas were to ignite before treatment with prescribed fire.

Direct and Indirect Effects

No hazardous fuel reduction treatments would occur in the no action alternative. This alternative would have limited effect on the current state of fuels and fire in the short term.

The fuels complex would continue to move to denser conditions with more dead fuel accumulating. Overall fuel height would continue to increase and already close canopies would become denser. Standing dead brush and pinyon-juniper continue to increase as a result of the 8-year drought in southern Utah. Fuels conditions would remain in a high severity, infrequent stand replacement fire regime.

The steep canyons, and dense fuels adjacent to these communities have the potential to burn hot enough to prevent safe and effective deployment of suppression resources for the protection of individual homes, communities and watershed values. Predicted fire behavior modeling of representative fuel types indicates that high intensity fire with high flame lengths and rapid rates of spread would be likely under moderate and higher weather conditions.

It is typical in the current fuel type to have flame lengths and fireline intensities that render control efforts ineffective. In these fuel types, firefighters create or move to a change in fuel type where control efforts will be more effective. Potentially extreme fire behavior in the wildland urban interface and adjacent areas would not change in this alternative.

In the long term, it is expected that some of the lightning fires will escape initial attack and grow uncharacteristically large. Since fire exclusion has limited fire's role in these ecosystems for more than 150 years, the fires would burn with more intensity, longer flame lengths and higher severity as crown fires than would have been typical earlier. These crown fires would continue to threaten nearby human development, both through the fires themselves and also through the watershed damage afterward.

As potential flame length and fireline intensity increase, resistance to control increases. Flame lengths, (utilizing BEHAVE runs and observations from previous wildfires), expected in untreated oak brush and pinyon-juniper fuel types will be on the order of 45 feet and 13 feet respectively, with a 12 mph wind and 20% slope (Behave Information and Fire Suppression Interpretations, Attachment 4). Fireline production rates for a 20-person type 2 crew in oak brush and pinyon-juniper fuel are 3 and 4 chains/hour respectively (198 and 264 feet/hour) (NWCG, Fireline Handbook, pg A-20). In other words, the fire fighters that we have cannot build fire line to stop the fire as fast as the fire can burn. This makes it harder to fight the fire successfully– the fire moves faster than a typical crew can build line.

The increased costs, both of fighting the wildfires and rehabilitating watershed damage afterward would likely continue to increase in the long term as more of the area burns through unwanted wildland fires.

Alternative Two- Proposed Action

Hazardous fuels would be reduced on treatment areas using cutting, cutting and prescribed burning, and prescribed burning. Hazardous fuels reduction or fuel removal would change fire behavior, creating shorter flame lengths and lower fire intensity. . Although some wildland fires may escape initial attack, the various fuels treatments would limit fire behavior within the treated units. Fires within the treated units would exhibit lower flame lengths and lower fire intensities. This change in fire behavior would serve two purposes:

1) it will make initial attack safer and faster and make fighting the fire less risky

2) it will create lower intensity and lower severity fires, which would reduce the possibility of other resource damage, ie, soil and watershed damage

Firefighters can safely attack up to four-foot flame length with handtools. Fireline intensity at four-foot flame lengths is about 100 Btu/ft/sec. Engines can safely attack fires with flame lengths up to eight feet. Eight foot flames produce about 500 Btu/ft/sec. Surface fuel loading would be reduced to or kept below 5 tons/acre.

Comparison of Alternatives

Fire Behavior Modeling

Two models were used. Flammap was used to examine differences between treated and untreated fuels exhibited flame lengths and possibilities of active or passive crown fire behavior. BEHAVE was used to examine both flame lengths and fire intensities on treated and untreated units. Results of both these models are displayed in full in Attachments 4 and 5, Flammap and Fire Behavior and Suppression Information.

Utilizing the FLAMMAP model and ground truthed data from the Southern Utah Joint Fire Sciences Project, Rick Stratton (fire modeling specialist, Missoula Fire Lab, Missoula, MT.) and Scott Tobler (Fuels Specialist, Dixie National Forest, Cedar City, UT) showed more than a 50% reduction in flame length on each unit. Before treatment, the units averaged 14-foot flame lengths. After treatment, flame lengths were 5 feet or less (see Flammap, Attachment 5,). FLAMMAP is good model to utilize to predict crown fire potential

	Flame Length	
Unit	**Alternative 1 Wildfire**	**Alternative 2 Proposed Action**
Grabalt	16 feet	<5 feet
Wild Goose	11	<5 feet
Holden Springs	11	<5 feet
Pioneer	16	<5 feet
Frampton Heights	16	<5 feet
Horse Hollow	11	<5 feet
Meadow	11	<5 feet

Table 8. Flame length results of Flammap model for Pahvant units

. BEHAVE does not predict crown fire behavior, but does predict flame length and fireline intensity. All modeled parameters are included in Attachment 4, Fire Behavior and Suppression Information and the discussion of direct and indirect effects, above.

	Fire Intensity		Flame Length	
Unit	**Alternative 1**	**Alternative2**	**Alternative 1**	**Alternative2**

	Wildfire	Proposed	Wildfire	Proposed
Grabalt	9840	136	31	4
Wild Goose	9840	136	31	4
Holden Springs	643	15	9	1.6
Pioneer	9840	136	31	4
Frampton Heights	643	15	9	1.6
Horse Hollow	9840	136	31	4
Meadow	9840	136	31	4

Table 9. Fire Intensity and Flame Length, utilizing BEHAVE with a mid-flame wind speed of 6 mph.

Although each model uses slightly different assumptions (hence the difference in actual flame length numbers) the end result is the same for both Flammap and BEHAVE. Treatments lowered potential for crown fire activity, lowered flame lengths and fireline intensity, indicating that purpose and need could be met through these proposed treatments.

A reduction in flame length would make it easier to initial attack a new fire. Anything fewer than 4 feet in flame length in considered relatively safe for firefighters to directly attack. Up to eight feet in flame length is still safe for engines to directly attack. If the flame lengths are greater than 8 feet, then heavy equipment or aerial attack are necessary to safely attack the fire.

	No Action - Wildfire Conditions		**Proposed Action - Year 1**	**Proposed Action - Year 10**
Fuel Height (ft)	25+	3	< 2' average	2-10
Fuel Loading (tons/acre)	30	3	< 5 average	1-15 *
Flame Length (ft)	30	9	1.6 - 4	10
Fire Intensity	10,000	500	15 or 136	819
Fire Regime and Condition Class	Infrequent, stand replacing fires would continue, (FR IV) moving toward condition class three in all vegetation types		Move toward more frequent, lower intensity fires in treated units (FR III), move toward condition class one for all 3 vegetation types	

Table 10. Modeled using 12 mph 20' wind speed with 0.5 wind reduction. See BEHAVE information, Attachment 4. * Oak will resprout, possibly quickly enough to reach 15 Tons/acre in 10 years.

Cumulative Effects Area

The cumulative effects area is the analysis area, which covers 287,487 acres. This includes 95,623 acres of nonfederal lands, including communities and other in holdings. The affected environment includes all vegetation within and adjacent to the treatment area with the assumption that all fuels within a contiguous fuel unit will burn similarly, that is, if an area of similar fuel begins to burn, it is likely that the entire fuel unit would burn because the vegetation and fuels conditions are similar across the area.
This proposal is to treat up to 14,329 acres of this area.

Cumulative Effects common to all alternatives

Cumulative effects examine the effects of the alternatives taken in combination with past, present and reasonably foreseeable future actions.

Under the no action alternative, impacts to the current fuels profile in the project area would be negligible in the short term and moderate to high in the long term. The no-action alternative assumes that current conditions and current management would stay the same and that fuels would continue to accumulate at above historic levels. Ignitions and potentially uncharacteristic wildfires are anticipated to move both in and out of the wildland urban interface with no change to fuels conditions. Lightning would continue its lengthy history (data from 1970-2001) of lighting more than 30 wildfires per year in the Pahvant section of the Fillmore Ranger District.

Although historical fuels have changed, in part due to grazing use, fire has continued to occur, albeit at a lower than historical rate. Most of the fuels in the BLM treatment units have already been cut under previously completed environmental assessments. This down and dead fuel would cause an extreme increase in fire behavior if left untreated by prescribed burning, and an unplanned ignition occurred on those units. In the action alternative there is enough fuel present, even with grazing, once units are cut the residual fuels can be successfully burned.

Ongoing and future fuels and ecosystem restoration projects would continue to occur along the Pahvant front. . Wildfires would continue to occur, although they are unpredictable. The upward trend in ignitions and burned acres is expected to continue at least until the drought breaks. Under the proposed action approximately 5% of the cumulative effects area fuels would be modified. These treatments would provide areas where firefighters can work safely to limit wildfire spread to protect values at risk.

Past actions affecting fuels were chaining on BLM and Forest Service lands, and other rangeland improvements. Ongoing projects include hazardous fuels reduction on approximately 2-4% of the cumulative effects area over the next 5 years.

Wildfires have occurred on 9% of the area in the past 10 years. Wildland fires (whether unwanted or used for resource benefit) would continue to modify the landscape although the results are not predictable or foreseeable. Continuing to suppress all wildfires is likely to impact ecosystem function and process in these disturbance-based ecosystems.

Fuels treatments proposed may require maintenance as fuels regrow. This analysis includes the possibility of one entry into each Gambel unit for maintenance purposes over the next 10 years. A new analysis would be completed for maintenance prior to that if warranted by a change in ecosystem health or process requirements.

Maintenance would be based on need and would occur in different areas at different times triggered by fuel growth, fuel type and fire behavior modeling. The intent is to maintain less than an 8' flame length fire behavior scenario. Brush fuels may need maintenance due to relatively rapid resprouting, particularly Gambel oak. The Meadow, Horse Hollow, Pioneer and Wild Goose units all have more than 30% Gambel oak vegetative cover. Treated pinyon-juniper and sagebrush/grass/forb vegetation types probably would not need a maintenance entry within 10 years.

Method of maintenance would be similar to the initial treatment. Fuels would be maintained by broadcast burning the same units. Maintenance would concentrate on original project purpose and need, that is, to maintain reduced ground fuel loading (≤ 5 tons/acre) which would create reduced fire intensity and flame length.

Additional past, connected and reasonably foreseeable future actions that would affect fire and fuels in the proposed project area include past wildland fires and fuels projects on Federal Lands in the analysis area. The Fishlake National Forest Fire Management Plan as amended by the 2001 Utah Fire Amendment allows for wildland fire for resource benefit across much of the Fillmore District of the Fishlake National Forest. Cumulative impacts of this decision are addressed in the Utah Fire Amendment and are available through the Dixie National Forest website at http://www.fs.fed.us/dxnf/ufmp/index.html. The main result of ongoing fuels work and decisions included in the Utah Fire Amendment, Fishlake National Forest Plan, the BLM Warm Springs Resource Management Plan, as amended by the Richfield District 1998 Fire Management Plan, would be increased patchiness and increased structural and species diversity due to wildland fire, prescribed fire and other mechanical fuels work.

The above actions are anticipated under the no action and proposed action alternatives and may provide a coordinated framework for forest ecosystem restoration across a large area. This will be a slow process. Expected benefits include: increased fuel heterogeneity across the analysis area; a move toward more resilient fire regimes and condition classes; and improved firefighter ability of to defend the urban interface and associated watershed values in large fire situations.

Conclusions

Ignitions will continue to occur. Under the no action alternative, fuel conditions would continue to move to a more hazardous, dense, high dead to live fuel ratio situation. Resistance to fire control would increase, while the ability to provide for firefighter and public safety and structure protection in the case of wildland fire would continue to decrease.

Over the past 5 years, the interagency prescribed fire program has successfully treated more than 8000 acres (on average) per year. This work was done under a number of different NEPA decisions issued by each agency. Projects included both wildland urban interface treatments and ecosystem restoration.

Effects to the overall fuels profile across the analysis area would be limited, although the purpose and need would be met. The fire behavior would be much reduced on the treated units (Table 10) allowing for safer initial attack and therefore lower risk of a fire reaching uncharacteristic size. These treatments would limit potential for large, uncharacteristic wildfires to encroach on private property. The project is not intended as an overall ecosystem restoration project, but rather to reduce fire behavior in the wildland urban interface and provide a space where firefighters can work safely to protect values at risk. Fire regimes in fuels adjacent to the treatment units would remain mixed to high severity.

Thanks to Steve Zieroth (fire ecologist) and Linda Wadleigh (fire ecologist) for editorial comments.

Citations

Anderson, Hal E., 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. National Wildfire Coordinating Group, General Technical Report INT-122, 22 p.

Bradley,Anne F., Nonan V. Noste and William C. Fischer. Fire Ecology of Forests and Woodlands in Utah. 1992. Intermountain Research Station GTR INT-287, Ogden, Utah, 128 p.

Chappell, Linda M., Robert Campbell, Jr., and Kevin P. Greenhalgh. 1997. A Fire History Study Conducted on the Monroe Mountain Demonstration Area, 1997, unpublished, Fishlake National Forest, 25 p.

Deeming, John E., Burgan, Robert E and Cohen, Jack D., 1977. The National Fire-Danger Rating System—1978. USDA Forest Service General Technical Report, INT-39, 63 p.

Kay, Charles E. 2002. The use of Repeat Photos to Evaluate Long-Term Vegetation Change and Land Management in South-Central Utah, Final Report. Utah State University, Logan UT 84322.

Miller, Richard F. and Tausch, Robin J. 2002. The Role of Fire in Juniper and Pinyon Woodlands: A Descriptive Analysis. *In* Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: the First National Congress on Fire Ecology, Prevention, and Management. Miscellaneous Publication No. 11, Tall Timber Research Station, p. 15-30.

National Wildfire Coordinating Group, 1989. Fireline Handbook, NWCG Handbook 3. PMS 410-1, Washington, DC, 146 p. plus appendices.

Ottmar, Roger D., Vihananek, Robert E., and Regelbrugge, Jon C., 2000. Stereo photo series for quantifying natural fuels. Volume IV: pinyon-juniper, sagebrush, and chaparral types in the Southwestern United States. PMS 833. Boise, ID: National Wildfire Coordinating Group, National Interagency Fire Center, 97 p.

Ottmar, Roger D., Vihananek, Robert E., and Regelbrugge, Jon C., 2000. Stereo photo series for quantifying natural fuels. Volume I: Mixed Conifer With Mortality, Western Juniper, Sagebrush, and Grassland Types in the Interior Paciric Northwest. PMS 830. Boise, ID: National Wildfire Coordinating Group, National Interagency Fire Center, 73 p.

Rothermel, Richard C., 1972. A mathematical model for predicting fire spread in wildland fuels. USDA Forest Service Research Paper, INT-115, 40 p.

Citations, continued

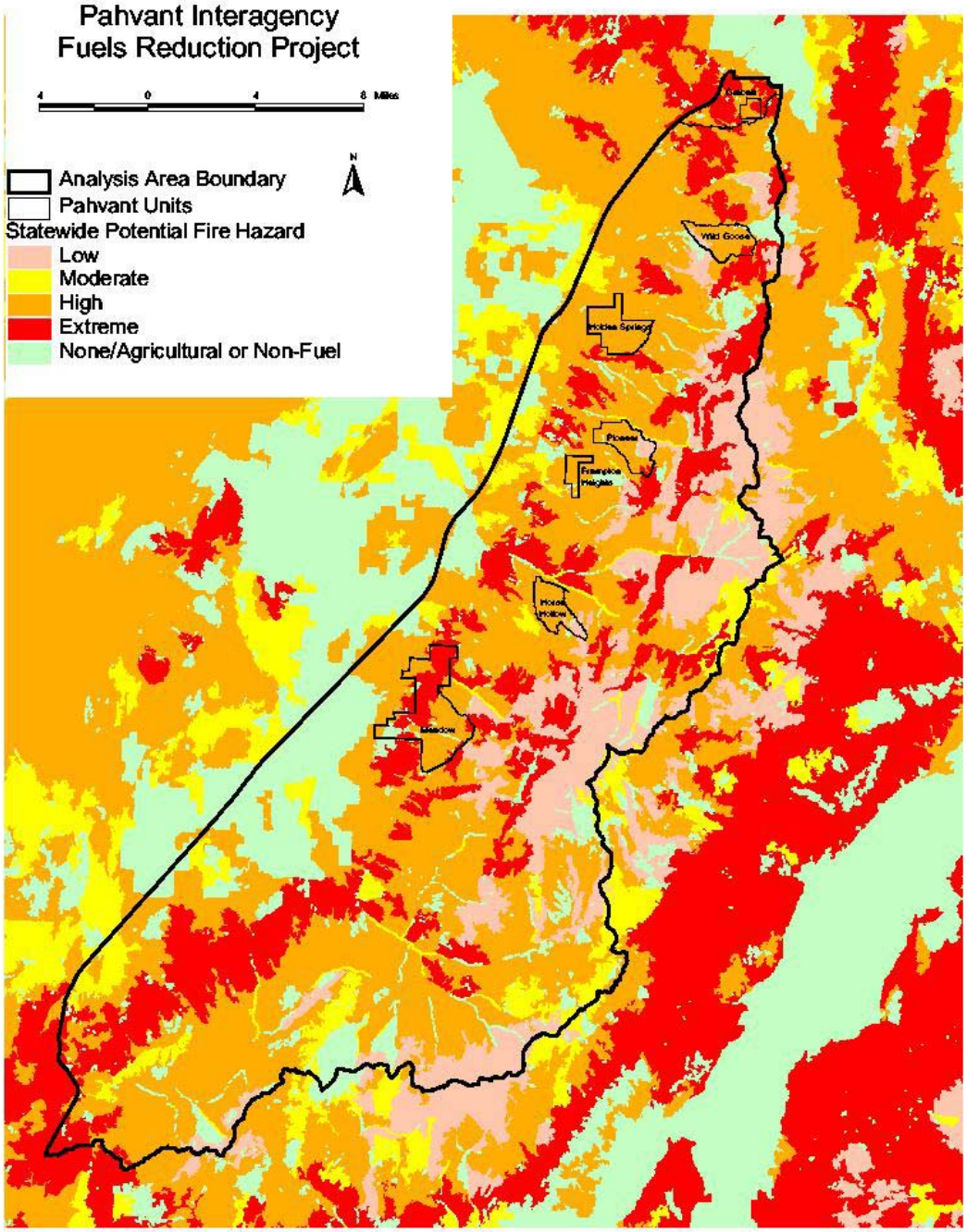
Statewide Fire Assessment. 2000. Bureau of Land Management Utah State Office Salt Lake City, Utah http://www.ut.blm.gov/Fire/assessment/process.html

USDA Forest Service. Restoring Fire-Adapted Ecosystems on Federal Lands, a cohesive strategy for protecting people and sustaining natural resources, 2000. Updated in draft form, 2002.

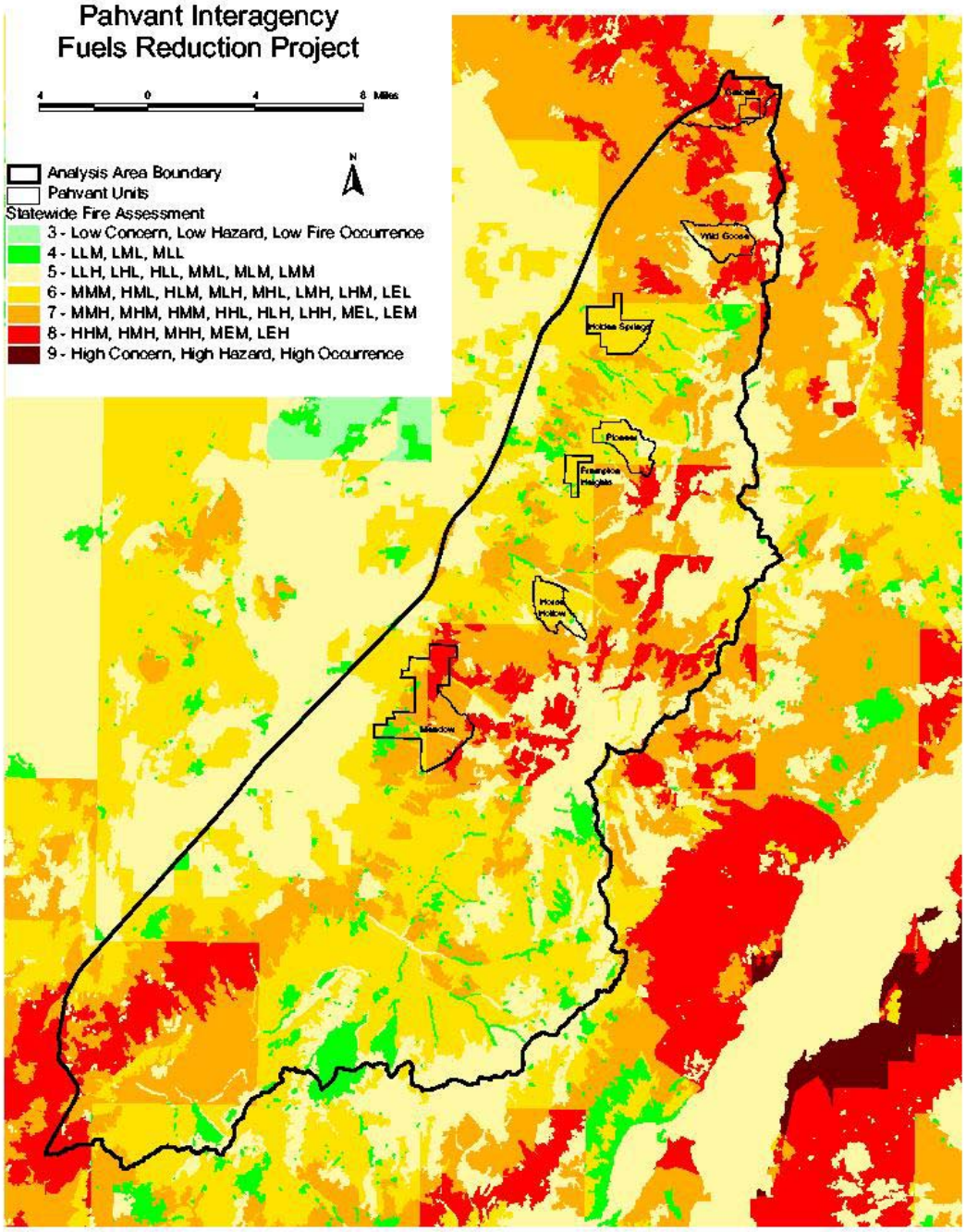
USDA Forest Service, Utah Fire Amendment Environmental Assessment, Intermountain Region, Ogden, UT. Ashley, Dixie, Fishlake, Manti-La Sal, Wasatch-Cache and Uinta National Forests, 2001. 184p. http://www.fs.fed.us/dxnf/ufmp/UFA.pdf.

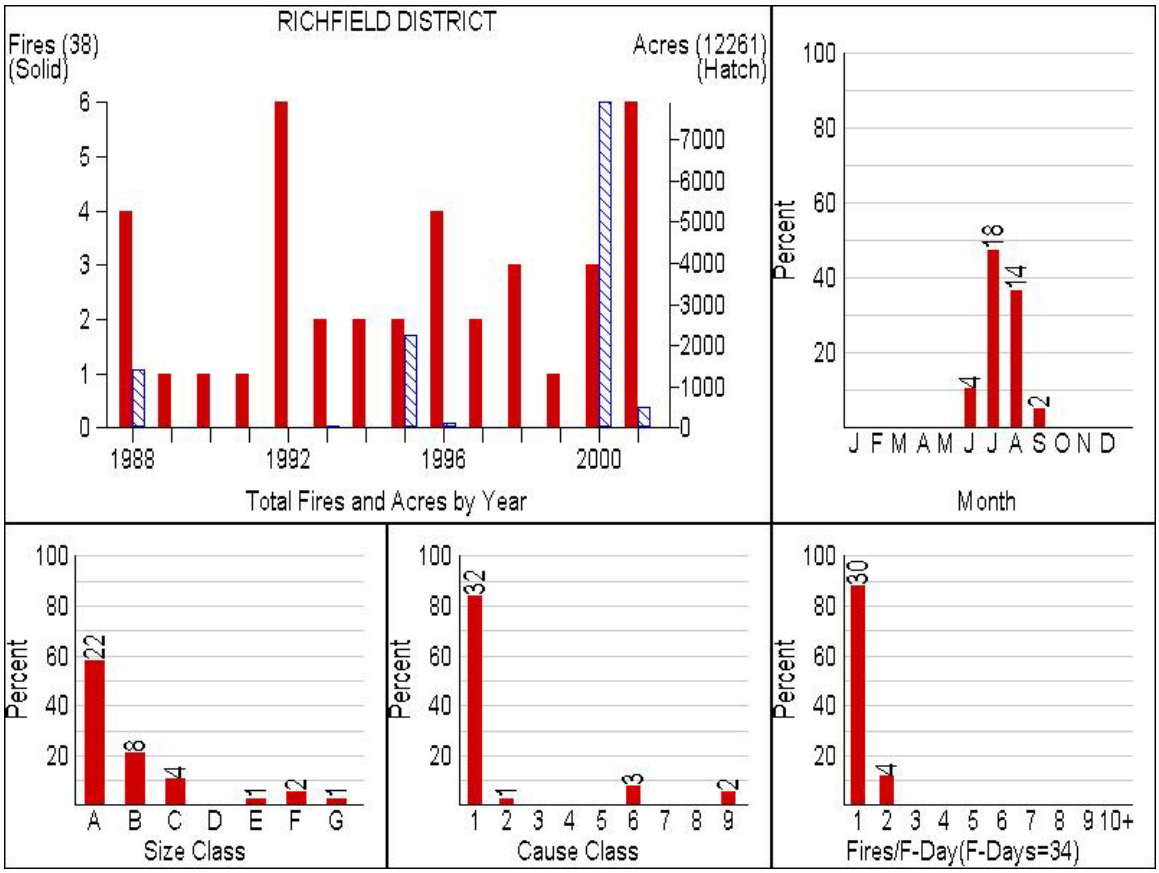
USDI/USDA. 1995. Federal Wildland Fire Management Policy, Final Report. National Interagency Fire Center, Boise, ID. 45p.

Utah Statewide Interagency Potential Fire Hazard



Utah Statewide Interagency Fire Risk Assessment

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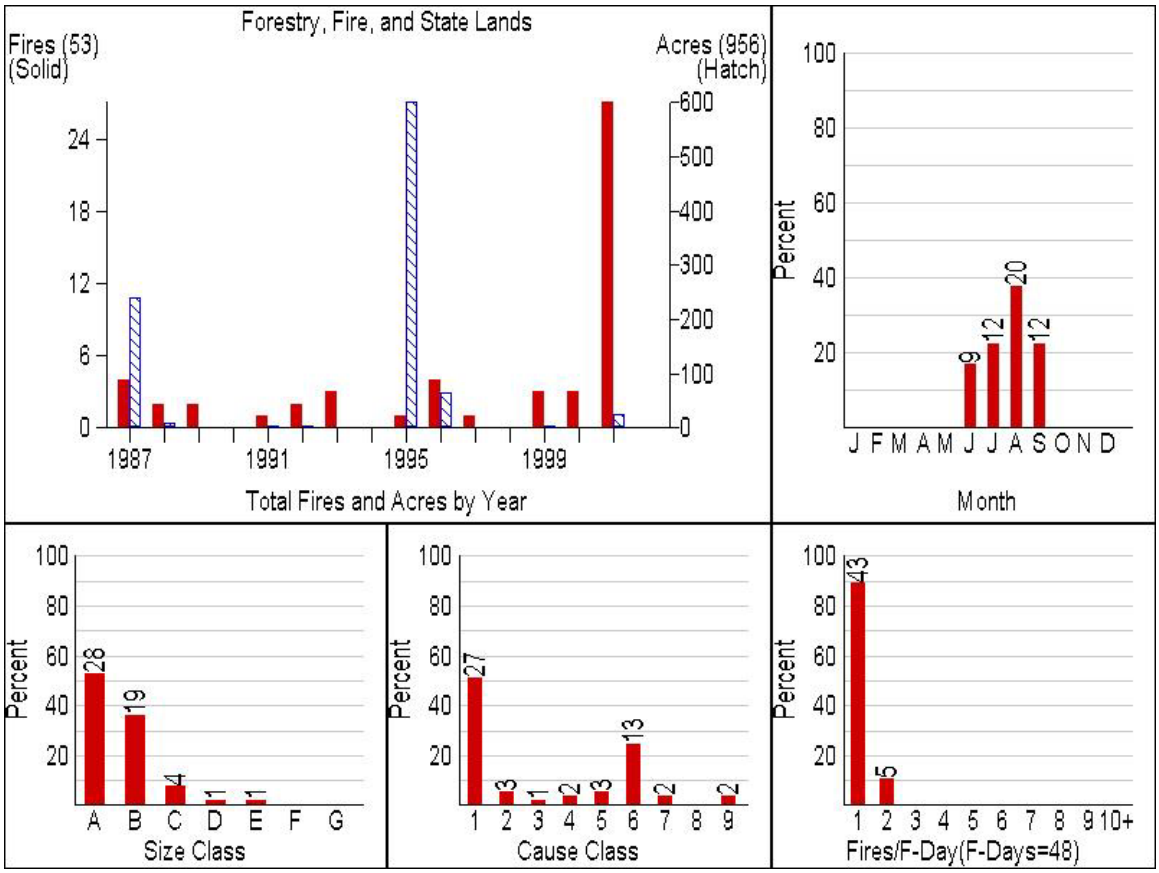
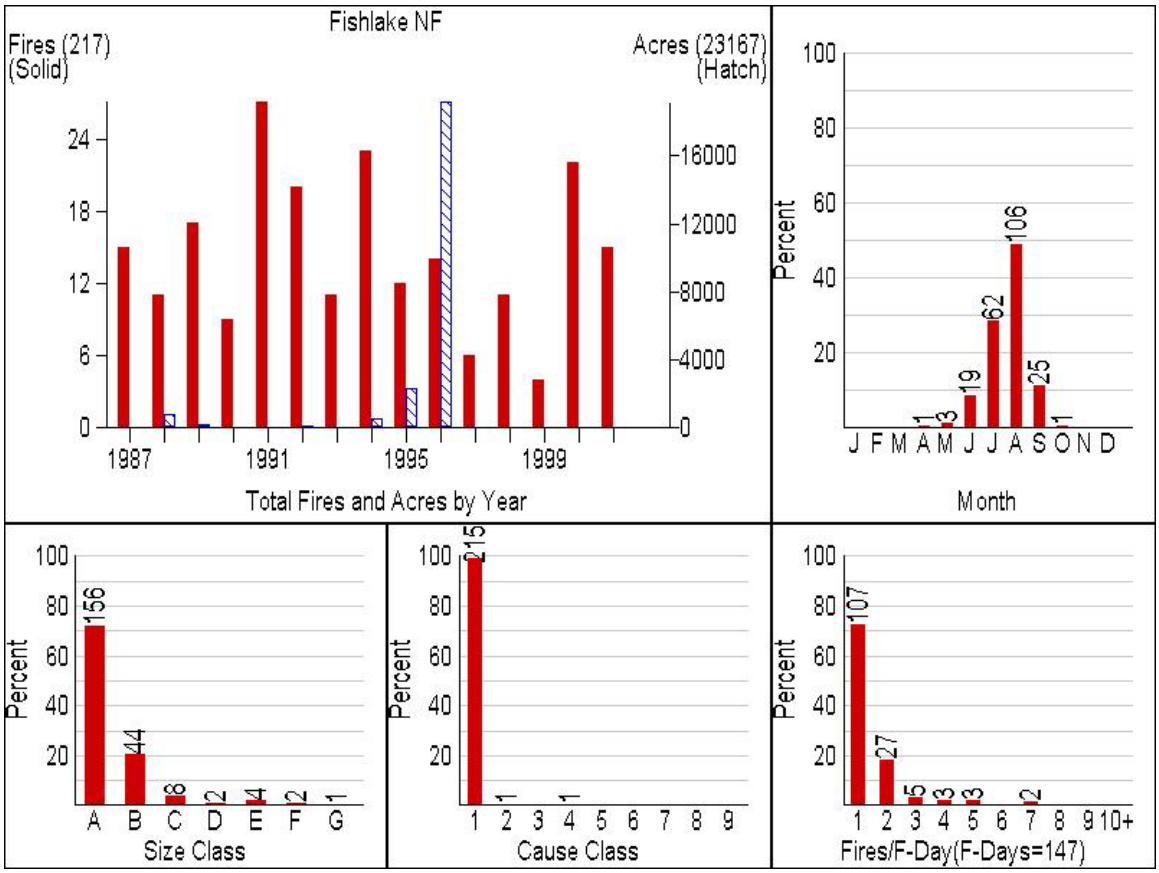
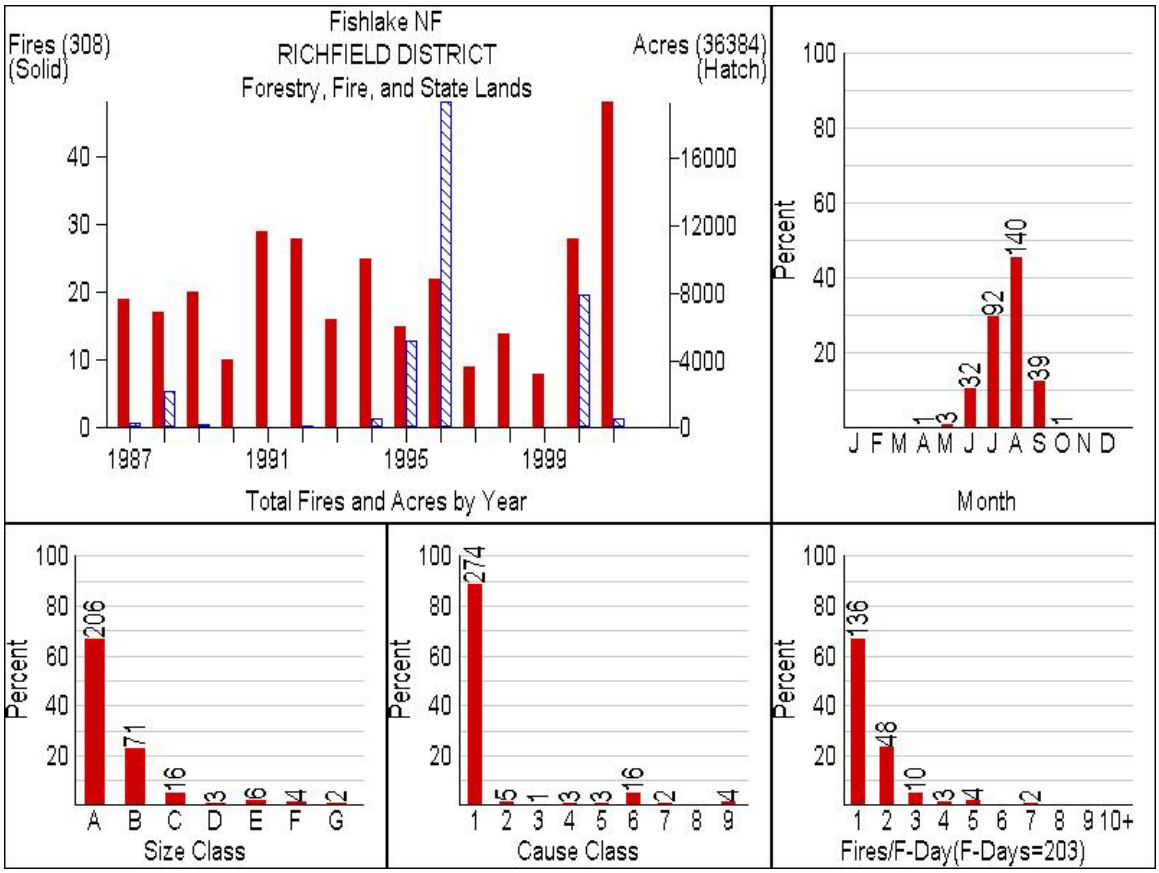
(Solid)
Acres (12261)
(Hatch)
Total Fires and Acres by Year
Month
Percent
J F M A M J J A S O N D
4
18
14
2
Size Class
A B C D E F G
22
8
4
1
2
1
Cause Class
1 2 3 4 5 6 7 8 9
32
1
3
2
Fires/F-Day(F-Days=34)
1 2 3 4 5 6 7 8 9 10+
30
4


Forestry, Fire, and State Lands
Fires (53)
(Solid)
Acres (956)
(Hatch)
0
6
12
18
24
0
100
200
300
400
500
600
1987
1991
1995
1999
Total Fires and Acres by Year
Percent
20
40
60
80
100
9
12
20
12
J F M A M J J A S O N D
Month
Percent
28
19
4
1
1
A B C D E F G
Size Class
Percent
27
3
1
2
3
13
2
2
1 2 3 4 5 6 7 8 9
Cause Class
Percent
43
5
1 2 3 4 5 6 7 8 9 10+
Fires/F-Day(F-Days=48)


Fishlake NF
Fires (217)
(Solid)
Acres (23167)
(Hatch)
Total Fires and Acres by Year
Month
Size Class
Cause Class
Fires/F-Day(F-Days=147)
Percent


Fishlake NF
RICHFIELD DISTRICT
Forestry, Fire, and State Lands
Fires (308)
(Solid)
Acres (36384)
(Hatch)
Total Fires and Acres by Year
Month
Size Class
Cause Class
Fires/F-Day(F-Days=203)
Percent

Meadow Picture Plot

UTM N4302150
E383469

North

West

East

South

UTM N 4311561
E 389491
Section 35A

	Total	1 hr	10 hr	100 hr	1000 hr	
Site Average	**14.15**	**0.18**	**1.32**	**3.12**	**4.10**	**8.72**

PLOT # 1

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	0	0.0122	0.48	1.15	1	6	0.00	
.25 - 1	11.64	0	0.304	0.48	1.13	1	6	0.00	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	0.00	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT # 2

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	3	0.0122	0.48	1.15	1	6	0.04	
.25 - 1	11.64	1	0.304	0.48	1.13	1	6	0.32	
1 - 3	11.64	1	2.87	0.4	1.1	1	10	1.47	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	1.83	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT # 3

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	22	0.0122	0.48	1.15	1	6	0.29	
.25 - 1	11.64	5	0.304	0.48	1.13	1	6	1.60	
1 - 3	11.64	4	2.87	0.4	1.1	1	10	5.88	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	7.77	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

Unit 35A Horse Hollow

PLOT# 4

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	1	0.0122	0.48	1.15	1	6	0.01	
.25 - 1	11.64	0	0.304	0.48	1.13	1	6	0.00	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	0.01	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT# 5

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	10	0.0122	0.48	1.15	1	6	0.13	
.25 - 1	11.64	1	0.304	0.48	1.13	1	6	0.32	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	0.45	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT # 6

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	9	0.0122	0.48	1.15	1	6	0.12	
.25 - 1	11.64	0	0.304	0.48	1.13	1	6	0.00	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	0.12	

Unit 35A Horse Hollow

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	30	0.0122	0.48	1.15	1	6	0.39	
.25 - 1	11.64	8	0.304	0.48	1.13	1	6	2.56	
1 - 3	11.64	6	2.87	0.4	1.1	1	10	8.82	
3+ Rotten	11.64	2	25	0.3	1	1	35	2.49	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	2.49
							Total Tons	14.26	

Sum of the >3" $^{2\ sound}$	3	4							25
Sum of the >3" $^{2\ rotten}$									0

Location Unknown **Plot 16**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	35	0.0122	0.48	1.15	1	6	0.46	
.25 - 1	11.64	18	0.304	0.48	1.13	1	6	5.76	
1 - 3	11.64	6	2.87	0.4	1.1	1	10	8.82	
3+ Rotten	11.64	6	173	0.3	1	1	35	17.26	
3+ Sound	11.64	4	98	0.4	1	1	35	13.04	30.30
							Total Tons	45.33	

Sum of the >3" $^{2\ sound}$	5	4	4	6	8	4			173
Sum of the >3" $^{2\ rotten}$	3	4	3	8					98

Location Unknown **Plot 1**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	8	0.0122	0.48	1.15	1	6	0.10	
.25 - 1	11.64	4	0.304	0.48	1.13	1	6	1.28	
1 - 3	11.64	2	2.87	0.4	1.1	1	10	2.94	
3+ Rotten	11.64	1	16	0.3	1	1	35	1.60	
3+ Sound	11.64	3	272	0.4	1	1	35	36.18	37.78
							Total Tons	42.10	

Sum of the >3" $^{2\ sound}$	4								16
Sum of the >3" $^{2\ rotten}$	12	8	8						272

Unit 35A Horse Hollow

Location Unknown **Plot 2**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	17	0.0122	0.48	1.15	1	6	0.22	
.25 - 1	11.64	12	0.304	0.48	1.13	1	6	3.84	
1 - 3	11.64	4	2.87	0.4	1.1	1	10	5.88	
3+ Rotten	11.64	2	80	0.3	1	1	35	7.98	
3+ Sound	11.64	1	25	0.4	1	1	35	3.33	11.31
							Total Tons	21.25	

Sum of the >3" $^{2\ sound}$	4	8							80
Sum of the >3" $^{2\ rotten}$	5								25

Location Unknown **Plot 3**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	15	0.0122	0.48	1.15	1	6	0.20	
.25 - 1	11.64	8	0.304	0.48	1.13	1	6	2.56	
1 - 3	11.64	1	2.87	0.4	1.1	1	10	1.47	
3+ Rotten	11.64	6	86	0.3	1	1	35	8.58	
3+ Sound	11.64	1	25	0.4	1	1	35	3.33	11.91
							Total Tons	16.13	

Sum of the >3" $^{2\ sound}$	4	3	4	6	3				86
Sum of the >3" $^{2\ rotten}$	5								25

Location Unknown **Plot 4**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	8	0.0122	0.48	1.15	1	6	0.10	
.25 - 1	11.64	5	0.304	0.48	1.13	1	6	1.60	
1 - 3	11.64	1	2.87	0.4	1.1	1	10	1.47	
3+ Rotten	11.64	4	86	0.3	1	1	35	8.58	
3+ Sound	11.64	3	66	0.4	1	1	35	8.78	17.36
							Total Tons	20.53	

Sum of the >3" $^{2\ sound}$	6	4	5	3					86
Sum of the >3" $^{2\ rotten}$	5	5	4						66

Unit 35A Horse Hollow

UTM N 4310790
E 390131
SEC 35 B

	Total	1 hr	10 hr	100 hr	1000 hr	
Site Average	**15.15**	**0.28**	**1.72**	**3.86**	**4.37**	**10.22**

PLOT # 1

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	22	0.0122	0.48	1.15	1	6	0.29	
.25 - 1	11.64	3	0.304	0.48	1.13	1	6	0.96	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	1.25	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT # 3

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	25	0.0122	0.48	1.15	1	6	0.33	
.25 - 1	11.64	10	0.304	0.48	1.13	1	6	3.20	
1 - 3	11.64	6	2.87	0.4	1.1	1	10	8.82	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	12.34	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT # 3

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	12	0.0122	0.48	1.15	1	6	0.16	
.25 - 1	11.64	0	0.304	0.48	1.13	1	6	0.00	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	0.16	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

Unit 35B Horse Hollow

PLOT# 4

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	6	0.0122	0.48	1.15	1	6	0.08	
.25 - 1	11.64	1	0.304	0.48	1.13	1	6	0.32	
1 - 3	11.64	3	2.87	0.4	1.1	1	10	4.41	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	4.81	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT# 5

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	4	0.0122	0.48	1.15	1	6	0.05	
.25 - 1	11.64	0	0.304	0.48	1.13	1	6	0.00	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	0.00
							Total Tons	0.05	
Sum of the >3" ^{2} sound								0	
Sum of the >3" ^{2} rotten								0	

PLOT # 6

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	38	0.0122	0.48	1.15	1	6	0.50	
.25 - 1	11.64	3	0.304	0.48	1.13	1	6	0.96	
1 - 3	11.64	0	2.87	0.4	1.1	1	10	0.00	
3+ Rotten	11.64	0	0	0.3	1	1	35	0.00	
3+ Sound	11.64	0	16	0.4	1	1	35	2.13	2.13
							Total Tons	3.58	
Sum of the >3" ^{2} sound	`							0	
Sum of the >3" ^{2} rotten	4							16	

Unit 35B Horse Hollow

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	30	0.0122	0.48	1.15	1	6	0.39	
.25 - 1	11.64	8	0.304	0.48	1.13	1	6	2.56	
1 - 3	11.64	6	2.87	0.4	1.1	1	10	8.82	
3+ Rotten	11.64	2	25	0.3	1	1	35	2.49	
3+ Sound	11.64	0	0	0.4	1	1	35	0.00	2.49
							Total Tons	14.26	

Sum of the >3" $^{2\ sound}$	3	4							25
Sum of the >3" $^{2\ rotten}$									0

Location Unknown **Plot 16**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	35	0.0122	0.48	1.15	1	6	0.46	
.25 - 1	11.64	18	0.304	0.48	1.13	1	6	5.76	
1 - 3	11.64	6	2.87	0.4	1.1	1	10	8.82	
3+ Rotten	11.64	6	173	0.3	1	1	35	17.26	
3+ Sound	11.64	4	98	0.4	1	1	35	13.04	30.30
							Total Tons	45.33	

Sum of the >3" $^{2\ sound}$	5	4	4	6	8	4			173
Sum of the >3" $^{2\ rotten}$	3	4	3	8					98

Location Unknown **Plot 1**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	8	0.0122	0.48	1.15	1	6	0.10	
.25 - 1	11.64	4	0.304	0.48	1.13	1	6	1.28	
1 - 3	11.64	2	2.87	0.4	1.1	1	10	2.94	
3+ Rotten	11.64	1	16	0.3	1	1	35	1.60	
3+ Sound	11.64	3	272	0.4	1	1	35	36.18	37.78
							Total Tons	42.10	

Sum of the >3" $^{2\ sound}$	4								16
Sum of the >3" $^{2\ rotten}$	12	8	8						272

Unit 35B Horse Hollow

Location Unknown **Plot 2**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	17	0.0122	0.48	1.15	1	6	0.22	
.25 - 1	11.64	12	0.304	0.48	1.13	1	6	3.84	
1 - 3	11.64	4	2.87	0.4	1.1	1	10	5.88	
3+ Rotten	11.64	2	80	0.3	1	1	35	7.98	
3+ Sound	11.64	1	25	0.4	1	1	35	3.33	11.31
							Total Tons	21.25	

Sum of the >3" $^{2\ sound}$	4	8							80
Sum of the >3" $^{2\ rotten}$	5								25

Location Unknown **Plot 3**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	15	0.0122	0.48	1.15	1	6	0.20	
.25 - 1	11.64	8	0.304	0.48	1.13	1	6	2.56	
1 - 3	11.64	1	2.87	0.4	1.1	1	10	1.47	
3+ Rotten	11.64	6	86	0.3	1	1	35	8.58	
3+ Sound	11.64	1	25	0.4	1	1	35	3.33	11.91
							Total Tons	16.13	

Sum of the >3" $^{2\ sound}$	4	3	4	6	3				86
Sum of the >3" $^{2\ rotten}$	5								25

Location Unknown **Plot 4**

Size Class	Constant	n	d^2	s	a	c	n^1	Tons/Acre	
0 - .25	11.64	8	0.0122	0.48	1.15	1	6	0.10	
.25 - 1	11.64	5	0.304	0.48	1.13	1	6	1.60	
1 - 3	11.64	1	2.87	0.4	1.1	1	10	1.47	
3+ Rotten	11.64	4	86	0.3	1	1	35	8.58	
3+ Sound	11.64	3	66	0.4	1	1	35	8.78	17.36
							Total Tons	20.53	

Sum of the >3" $^{2\ sound}$	6	4	5	3					86
Sum of the >3" $^{2\ rotten}$	5	5	4						66

Unit 35B Horse Hollow

Attachment 4 Fire & Fuels Specialist Report

Behave Information and Fire Suppression Interpretations

Pre-treatment Vegetative Cover by unit:

Grabalt	20% Gambel oak 78% pinyon/juniper 2% Sagebrush/grass/forb
Wild Goose	42% Gambel oak 58% pinyon/juniper
Holden Springs	32% sagebrush/grass/forb 68% pinyon/juniper
Pioneer	29% sagebrush/grass/forb 33% Gambel oak 38% pinyon/juniper
Frampton Heights	35% sage/grass/forb 65% pinyon juniper
Horse Hollow	49% Gambel oak 51% pinyon/juniper
Meadow	1% riparian 21% pinyon/juniper 35% sagebrush/grass/forb 43% Gambel oak

The following reasoning was used to assign fuel fire behavior fuel models:

Pre-treatment

- If the average height of the stand was over six feet tall (mostly late seral Gambel oak and p/j), fuel model 4 was used
- If the average height of the stand was under six feet tall (mostly sagebrush/grass/forb), fuel model 6 was used

Post-treatment

- Any presence of Gambel oak indicated fuel model 9, as it sprouts well and the leaf litter would carry the fire.
- Recent treatments without oak will have mostly grasses, so fuel model 8 was used

- After 10 years of regrowth, it is assumed that all units have produced vegetation at the Fuel Model 2 level.

Fire Behavior Fuel Models Utilized

Unit	Fuel Model Pre-treatment	Fuel Model Post-treatment
Grabalt	4	9
Wild Goose	4	9
Holden Springs	6	8
Pioneer	4	9
Frampton Heights	6	8
Horse Hollow	4	9
Meadow	4	9

Behave Inputs

This is the FireFamily+ data used to complete BEHAVE modeling.

```
Percentile Weather, Black Cedar RAWS

FireFamily Plus Percentile Weather Report for RERAP

 Station: 421805: BLACK CEDAR            Variable: ERC
 Model: 7G1PE1
         Data Years: 1987 - 2001
         Date Range: May 1 - October 31
Wind Directions: N, E, S, W

Percentiles, Probabilities, and Mid-Points
    Variable/Component Range       Low       Mod       High      Ext
            Percentile Range     0 - 15    16 - 89    90 - 97    98 -
100
       Climatol. Probability        15        75         7         3
          Mid-Point    ERC      36 -  36   68 -  68   86 -  86   94 -
94
            Num Observations        20        59        28        12
     Calculated Spread Comp.         3         6         8         7
              Calculated ERC        36        68        87        95

Fuel Moistures
        1 Hour Fuel Moisture      11.00      4.90      2.90      2.20
       10 Hour Fuel Moisture      13.40      8.40      3.80      2.60
      100 Hour Fuel Moisture      13.10      6.80      5.10      3.90
    Herbaceous Fuel Moisture      93.90     48.30     36.60     35.10
         Woody Fuel Moisture     122.30     80.50     61.50     54.50
              20' Wind Speed       4.50      5.40      5.60      4.70
     1000 Hour Fuel Moisture      14.60      9.10      6.50      5.60

 2084 Weather Records Used, 1084 Days With Wind (52.02%)
```

Behave inputs were figured using the Black Cedar RAWS station (421805) data from the years 1987 through 2001. 90th percentile weather was used. The parameters are as follows: 1 hr = 3, 10 hr = 4, 100 hr = 5, woody = 61, various wind speeds were used, from 2-12 mph and the slope was averaged at 20%.

Behave Outputs

Pre-Treatment Fuel Model 4

Midflame Wind Speed	Flame Length	Fireline Intensity Btu/ft/s
2.0	17.2	2739
4.0	24.4	5905
6.0	30.9	9840
8.0	36.8	14376
10.0	42.2	19418
12.0	47.4	24904

Pre-Treatment Fuel Model 6

Midflame Wind Speed	Flame Length	Fireline Intensity Btu/ft/s
2.0	5.0	189
4.0	7.0	396
6.0	8.8	643
8.0	10.4	920
10.0	11.8	1222
12.0	13.2	1545

Post Treatment Fuel Model 8

Midflame Wind Speed	Flame Length	Fireline Intensity Btu/ft/s
2.0	0.9	5
4.0	1.3	9
6.0	1.6	15
8.0	1.9	22
10.0	2.2	30
12.0	2.3	35

Post Treatment Fuel Model 9

Midflame Wind Speed	Flame Length	Fireline Intensity Btu/ft/s
2.0	2.3	34
4.0	3.3	75
6.0	4.3	136
8.0	5.3	214
10.0	6.3	306
12.0	7.2	414

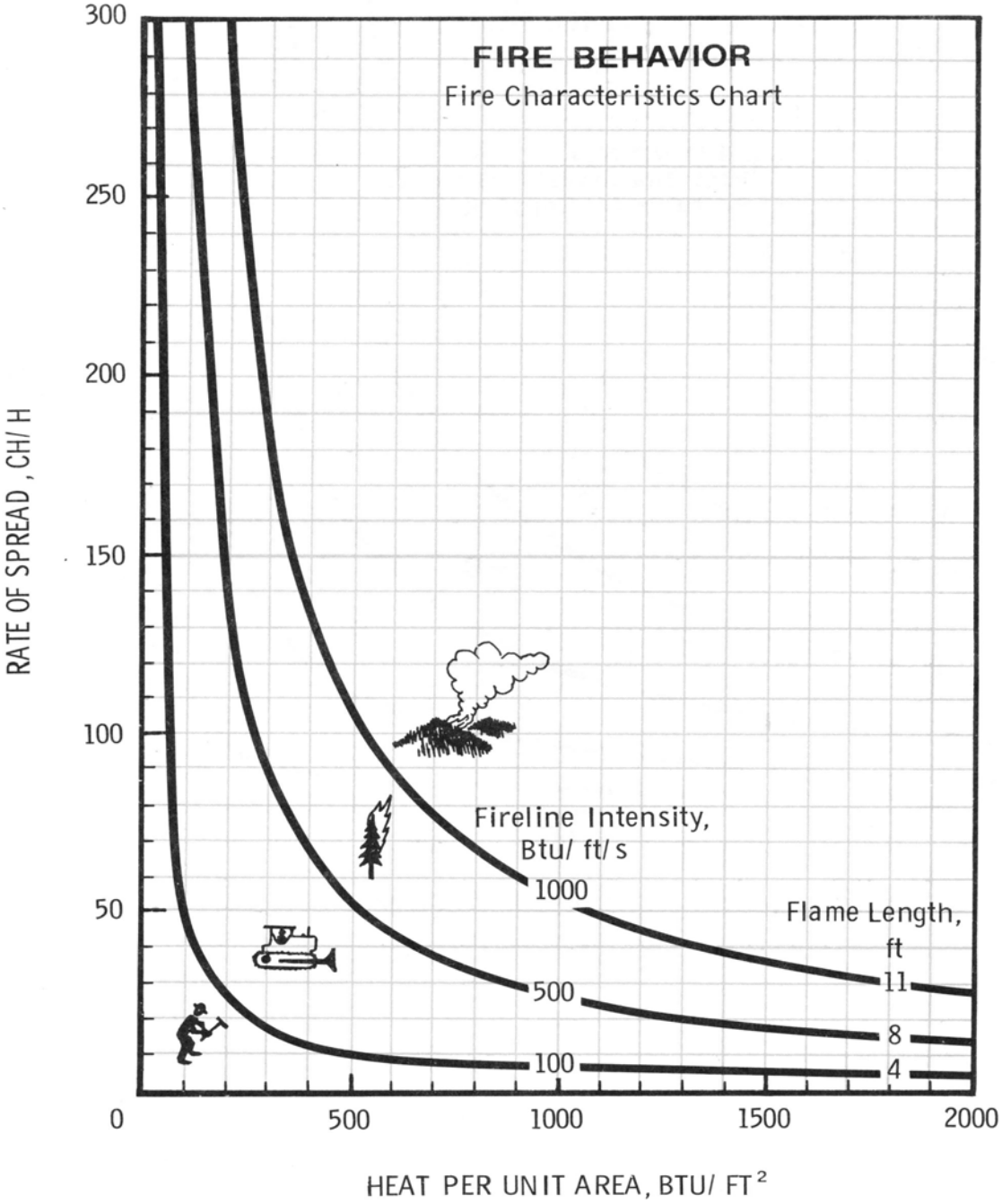
Post Treatment Fuel Model 2

Midflame Wind Speed	Flame Length	Fireline Intensity Btu/ft/s
2.0	5	172
4.0	7	428
6.0	10	819
8.0	12	1336
10.0	15	1973
12.0	17	2726

Fire Suppression Interpretations

Flame Length (Feet)	Fireline Intensity (Btu/ft/s)	Interpretations
< 4	< 100	• Fires can generally be attacked at the head or flanks by persons using hand tools. • Handline should hold the fire.
4-8	100-500	• Fires are too intense for direct attack on the head by persons using hand tools. • Handline cannot be relied on to hold fire. • Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8-11	500-1000	• Fires may present serious control problems —torching, crowning and spotting. • Control efforts at the fire head will probably be ineffective.
> 11	> 1000	• Crowning, spotting and major fire runs are probable. • Control efforts at head of fire are ineffective.

Rothermel and Rinehart,1983



GTR-INT-131 Charts for Interpreting Wildland Fire Behavior Characteristics

Andrews and Rothermel, 1982.

Anderson, Hal E., 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. National Wildfire Coordinating Group, General Technical Report INT-122, 22 p.

Andrews, Patricia L., and Rothermel, Richard C., 1982. Charts for Interpreting Wildland Fire Behavior Characteristics. USDA Forest Service General Technical Report INT-131, 21 p.

Andrews, Patricia L., Colin D. Bevins, Donald W. Carlton, Monte Dolack. 2001. Behave Plus software. Systems for Environmental Management, Missoula, MT

FLAMMAP Assessment

This assessment was completed utilizing data created at the Missoula Fire Lab. Don Long (GIS analyst), using vegetation information collected through a remotely sensed and then ground-truthed data set for a Joint Fire Sciences Project created the layers. Rick Stratton (fire modeling analyst) and Scott Tobler (fuels specialist) then used those layers in Flammap to predict post treatment outcomes for flame length and crown fire activity. They started with the Fire Lab data layers then they modified the vegetation within the treatment areas to reflect post treatment vegetation. The comparison was then made between the fire behavior with the current vegetation and the vegetation expected after the treatments.

0 – no crown fire
1 – surface fire
2 – passive crown fire
3 – active crown fire

Passive crown fire is typically exhibited through single tree or small group torching. Active crown fire occurs when the fire is moving independently of the surface fire through the stand. Either active or passive crown fires are impossible to fight with crews and engines; no direct attack can be utilized on these dangerous fires.

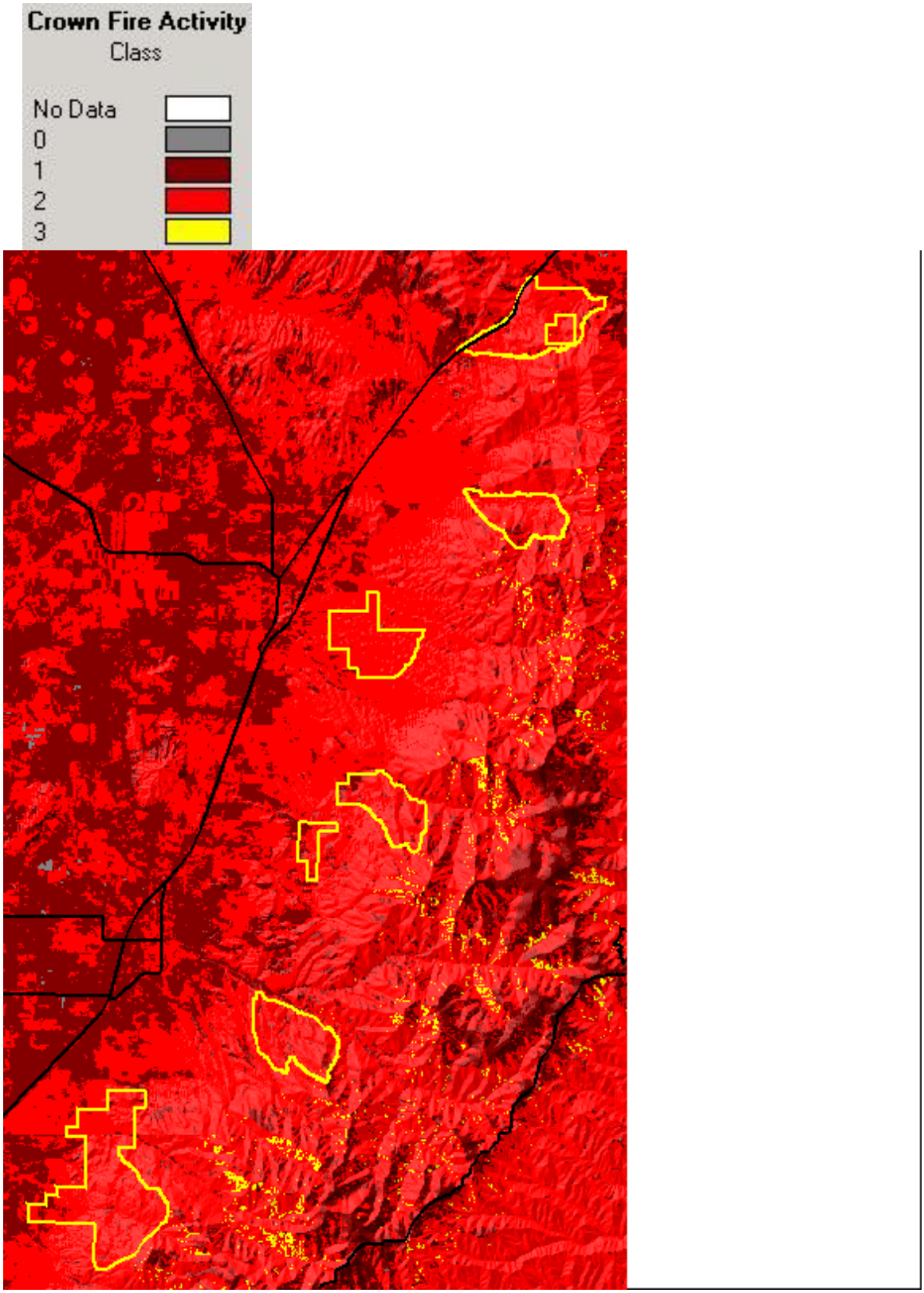
The next two pages show the difference by unit between pre and post –treatment crown fire expected. The following two pages show the reduction in flame length, which should occur on the units after treatment. There is a change from an average of pre treatment flame length averaging 16 or more to a post treatment flame length of about 5 feet. This reduction in flame length makes a fire safer and easier to deploy firefighters on successfully.

Conclusion: Treatments both lessened crown fire activity and lowered flame lengths, indicating that purpose and need could be met through these proposed treatments

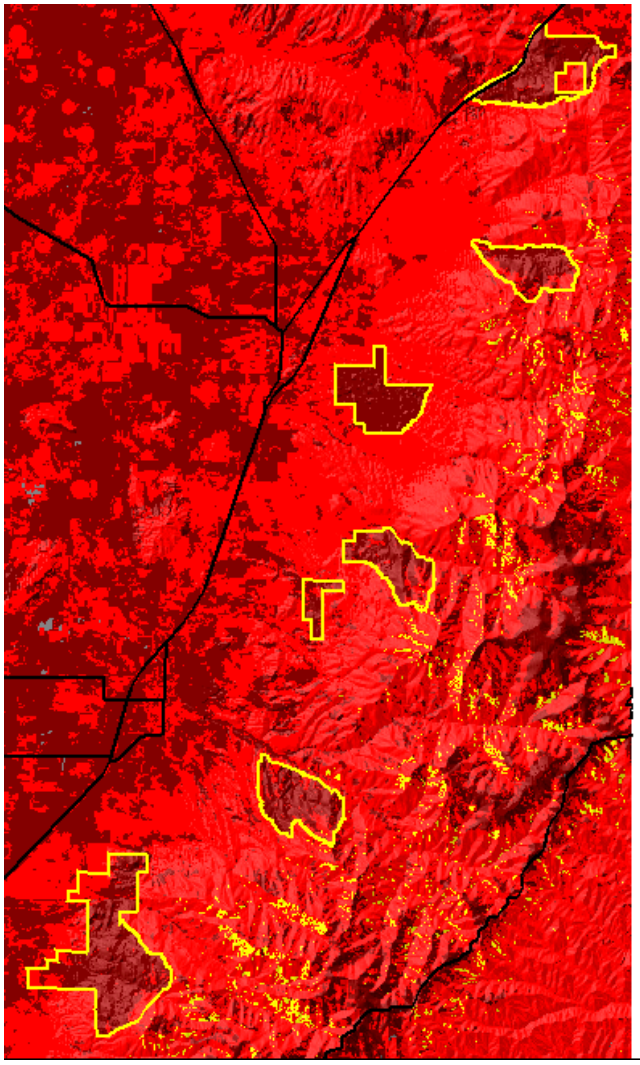
References:

Scott, Joe H., and Elizabeth Reinhardt. 2001. Assessing crown fire potential by linking models of surface and crown fire behavior. RMRS-RP-29. Fort Collins, CO. 60p.

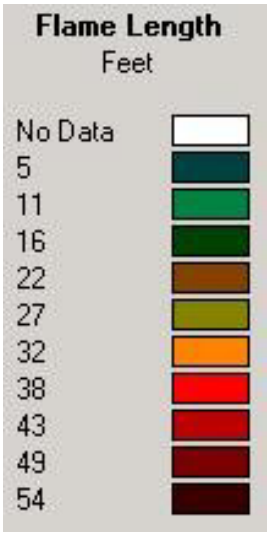
Crown Fire Activity Pre-Treatment

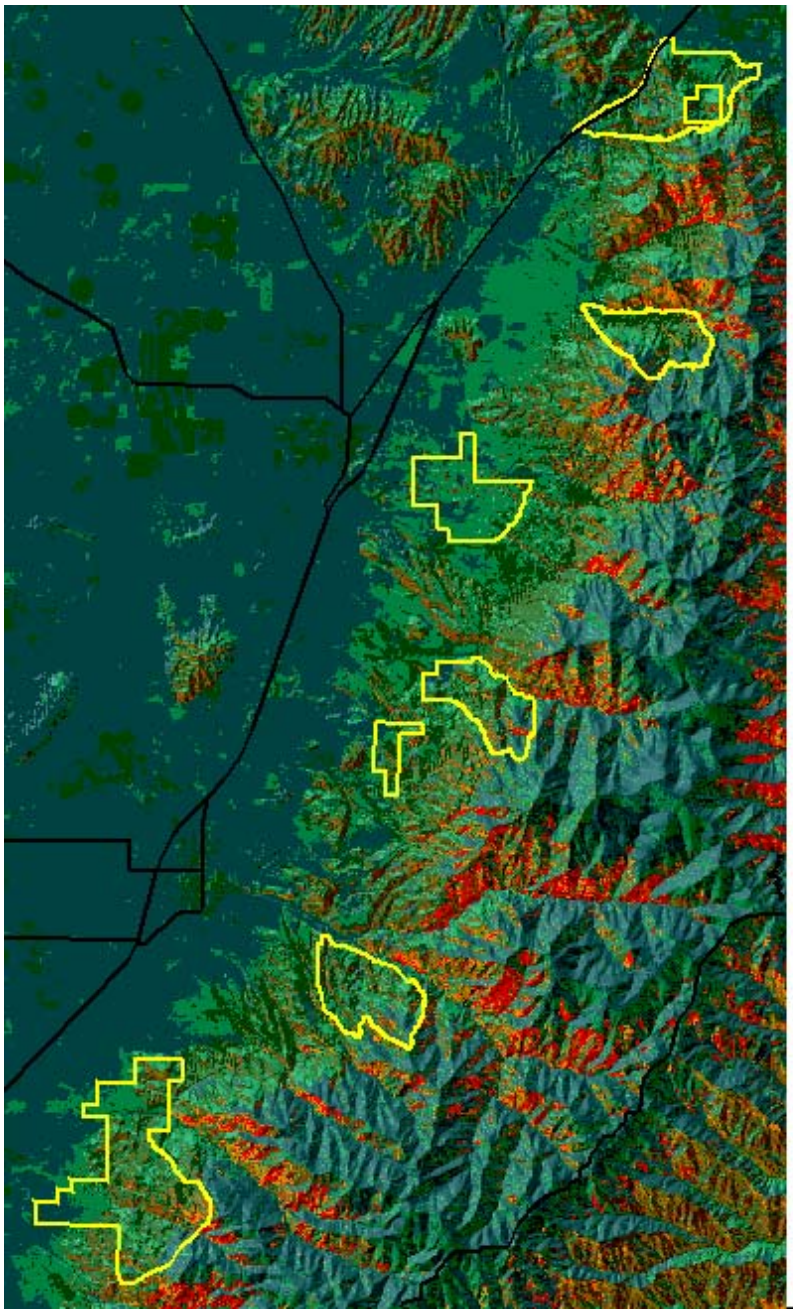
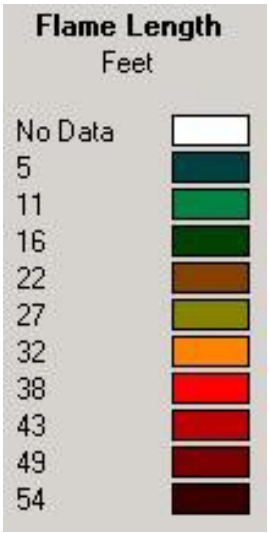
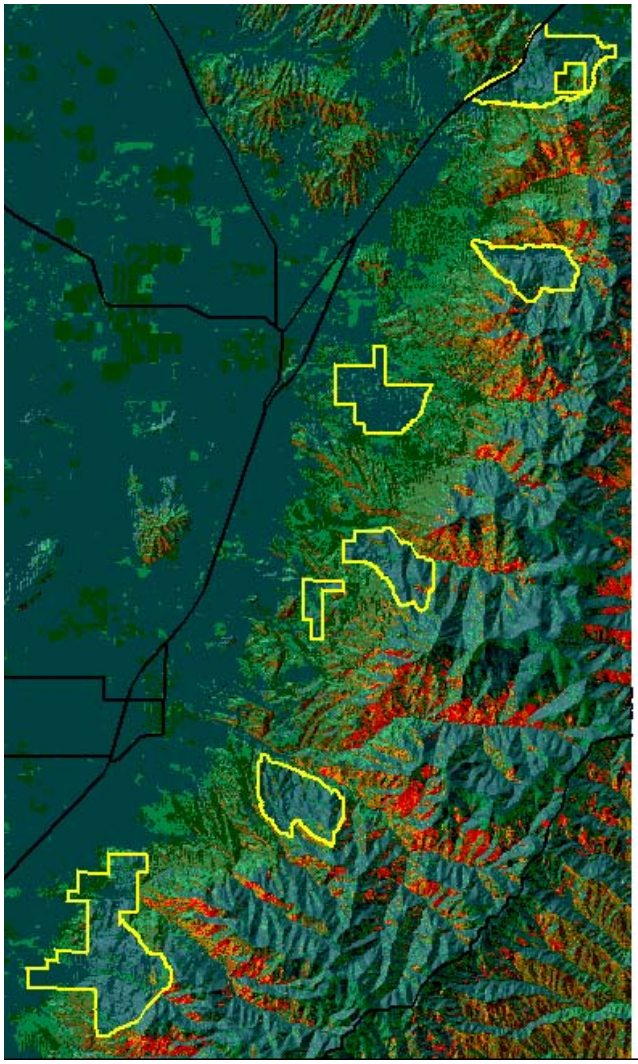


Crown Fire Activity Post-Treatment



Flame Length Pre Treatment





Flame Length Post Treatment